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REVIEW OF SOLAR OBSERVATIONS, 1891 TO 1895
(JUNE).

BY DAVID E. HADDEN.

Systematic observations of the Sun's surface were begun on August 1, 1890, and have been continued to the present time. During this time I have observed the solar disc on 960 days and have kept a complete record of the number of groups of spots, the total number of spots in these groups, and the number of faculæ or groups of faculæ, their relative size, location, and place of origin, whether on the visible disc, or appearing by rotation.

These observations have been published monthly in *The Review of the Iowa Weather and Crop Service*, and occasionally in a few other journals.

Most of this work was done with a 3-inch BRASHEAR telescope of Jena glass, using various eye-pieces, powers, and shade glasses. Latterly, I have given preference to the Herschelian wedge, using $\frac{1}{2}$ -inch and $\frac{3}{4}$ -inch eye-pieces and neutral green shade glass. The method of projection has also been much employed.

During the past year some observations of the prominences have been made with the spectroscope, using a 2-inch ROWLAND grating of 14,438 lines to the inch.

A few photographs about three inches in diameter were taken, and numerous pencil sketches of the larger and more remarkable groups were made.

The following tables exhibit the results of some of these observations for the years 1891 to 1894 inclusive, and a portion of 1895:

RESUMÉ OF SOLAR OBSERVATIONS, ALTA, IOWA.

1891.

MONTHS.	NUMBER OF OBSERVING DAYS.	MEAN DAILY NUMBER OF		
		GROUPS.	SPOTS.	FACULÆ.
January	25	1.0	2.7	1.7
February	20	1.6	7.3	1.3
March	21	1.1	2.5	2.2
April	23	1.9	12.2	3.1
May	28	3.6	16.8	4.1
June	17	4.2	16.9	5.3
July	24	3.5	26.1	5.7
August	18	2.2	13.0	4.4
September	23	4.0	23.1	5.2
October	23	4.6	19.5	3.6
November	17	3.8	23.1	3.6
December	18	3.4	15.6	3.1

1892.

January	24	5.8	28.0	4.1
February	13	5.0	46.0	3.5
March	14	3.2	14.0	3.1
April	13	4.6	21.5	4.6
May	5	5.6	30.0	2.6
June	23	6.0	35.0	4.4
July	22	6.2	56.9	4.4
August	23	7.6	38.4	5.1
September	18	5.3	30.2	5.7
October	22	5.7	41.6	4.6
November	15	4.7	35.4	3.2
December	13	7.4	31.1	4.0

1893.

January	13	6.1	42.3	3.5
February	15	5.1	42.4	3.4
March	17	5.1	30.0	3.3
April	15	7.3	31.5	3.9
May	19	8.1	31.5	4.5
June	8	7.0	46.7	4.6
July	22	7.4	49.3	4.4
August	21	9.4	53.8	4.7
September	24	6.1	34.6	4.4
October	10	6.7	30.7	4.7
November	7	6.6	24.7	4.0
December	6	4.8	21.7	3.0

1894.

January	9	7.2	40.0	3.7
February	19	6.4	26.6	2.9
March	8	4.6	21.0	3.8
April	7	5.3	25.4	3.7
May	13	6.1	33.5	3.0
June	20	6.8	30.3	3.4
July	20	7.3	34.6	3.8
August	13	4.5	22.1	3.2
September	10	4.7	17.5	3.3
October	12	4.6	34.6	3.6
November	7	4.4	16.6	2.8
December	1	5.0*	28.0*	4.0*

* Only one observation.

1895.

MONTHS.	NUMBER OF OBSERVING DAYS.	MEAN DAILY NUMBER OF		
		GROUPS.	SPOTS.	FACULÆ.
January	6	4.2		4.2
February	11	5.3	23.6	3.5
March	13	5.4	25.7	4.0
April	5	6.6	32.8	4.8
May	7	6.0	34.9	4.1
June	10	5.6	43.1	3.6

When the daily average number of Sun-spots is plotted graphically, marked fluctuations are noticed during the entire five years, but generally there is a constant increase in the number of spots during the period.

A small maximum appeared in July, 1891, and two maxima in 1892, viz: in February and July, that of July being the highest during the five years.

A secondary maximum was noted in the summer of 1893, commencing in the month of June and reaching the last maximum in August. After this, a steady decline set in, with slight irregular fluctuations during 1894 and first half of 1895.

The following are among the largest and more remarkable Sun-spot groups in the period under review:

August 29, 1891. A group containing one large spot is on the east limb. A very brilliant aurora was observed in the evening. On the following day the umbra was crossed with bright streaks.

August 31. Unusual activity in group, which has developed into two immense groups containing many large spots. Bright aurora visible last evening and to-night.

September 3. The large groups are now on the central meridian and are very fine, being visible to the naked eye. Aurora again to-night.

On September 6th the groups were breaking up into smaller spots and passed over the west limb on the 9th. The return of this disturbed area at the southeast limb on September 25th was again attended by brilliant auroras for several evenings.

January 18, 1892. Ten groups of spots are visible to-day, two very fine groups of well-defined umbra and penumbra.

January 19th. Eleven groups to-day.

February 5. An immense group of many large spots is just appearing by solar rotation.

February 7th. The great group is very fine, being easily visible to the naked eye. It consists of a very large penumbral

area containing two large black nuclei and smaller spots surrounding. This group underwent many changes from day to day, but still consisted of the two nuclei when it disappeared by solar rotation on the west limb, on the 18th, completing the transit in about thirteen and a half days. It was the largest group seen on the solar disc in nearly twenty years.

June 18. A fine group of large spots has appeared at east limb. Great activity on solar surface to-day; five groups are large, ten spots have fine umbra and penumbra.

June 19th. About 100 spots were counted in the six groups to-day. One large group in south latitude has a fine elongated nucleus, which on the 22d had divided into four parts and increased in extent, but was now less active and breaking up.

The month of July, 1892, witnessed another very fine display of solar activity, accompanied by some magnificent manifestations of terrestrial electricity.

On July 5th two large groups were noted near the east limb; the one northeast has an immense spot, the umbra of which is dividing into several parts. Many large groups appeared on the 7th, and 126 spots were counted on the 8th.

On the 10th several large elongated nuclei were observed in the groups in southeast quadrant; the largest group is breaking up into a large number of small spots.

On the 12th it was near the west limb still containing two fine nuclei, but the penumbral area is fast closing up the smaller spots surrounding it.

Three new groups formed on the 16th in various places, both north and south latitudes, and in the evening one of the finest displays of Northern lights observed in many years was noticed.

On the 25th many large groups again appeared, and the Sun's surface was dotted with ten to thirteen groups until the close of the month.

The month of August, 1893, was also rich in fine groups.

On the 3d considerable disturbance was noticed in the groups near the east limb in south solar latitude, which were increasing in size and number, and by the 5th had developed unusual activity; the region now contained an immense double group of very large penumbra and large nuclei, which was readily visible to the naked eye. A slight aurora was visible to-night.

This group was about on the central meridian on the 6th,

its appearance remaining about the same as on yesterday. A beautiful aurora was seen this evening.

On the 8th the large group is a superb object, being still easily visible to the naked eye, and its nuclei increasing some in size; the solar surface is completely spotted and a pretty sight.

On the 9th the large group is on the wane, the penumbra and nucleus breaking up; decreasing much in size on the 11th, but still a fine object when it disappeared by solar rotation on the 12th. It was the largest and finest group seen on the disc since the great group of February, 1892.

January 14 to 21, 1894. A large group is in the southern hemisphere visible to the naked eye.

February 15. Large group appeared by rotation to-day, which proved very interesting. The group was of an oval form with several nuclei; before disappearing at west limb, it decreased much in size and extent.

On the 19th, the $H\alpha$ line was brilliantly reversed in the umbra of this group; when the slit was widely opened the reversal had a flame or tree-like appearance.

Slight reversals were also observed on the 21st.

On the 25th the penumbra of the group was the location of bright reversals of the $H\alpha$ line, more especially north and southwest of the umbra, the umbra itself not appearing to be affected.

May 15 to June 5. Several large interesting groups made the transit of the disc during this period. They were still of large size and interesting during their next return from June 12th to 20th.

June 7. A remarkable eruptive prominence was observed this afternoon. At 5:15 P.M., an intensely brilliant prominence was noticed on the southeast limb, having the appearance of "spikes" and "flames." It seemed to be in violent commotion, as I found it almost impossible to delineate it. I estimated its height at about 70,000 miles. It was also very bright in D_3 and $H\beta$ lines. In about ten minutes the entire disturbance had nearly subsided, but a few faint flames remaining and a bright mass of "debris," which rested partly on and within the limb. The $H\alpha$ line was shifted much toward the blue end, indicating a rapid approach towards us. At 6 P.M. but little remained of this great disturbance, but turning my attention farther in on the disc, I found the entire region from the southeast limb to the

west portion of the group of spots (which was about two days in), to be in a violently agitated condition. At numerous points in this region, the *H α* line appeared with one or more dark, vibrating tongues or blow-pipe looking jets, directed towards the red end of the spectrum.

October 1 to 12. An extensive group appeared by rotation and made the transit of the disc, increasing much in size during its progress.

On the 10th an interesting feature of the group was a large square penumbral spot containing four large nuclei.

October 6. Much disturbance observed in *H α* line in the large group; several distortions towards blue end of spectrum, and reversals of *H α* line near the large group.

January 28, 1895. Reversals and distortions of *H α* line around the groups east of meridian.

April 28. All the groups on the Sun's disc to-day are large.

June 6. Active small protuberances near the new group on east limb; the region of spots and faculæ surrounding are also much disturbed.

June 16. Disturbances in and around the large group in northern hemisphere; reversals and distortions of *H α* line; bright stemmed prominence near a group on southeast limb.

The following tables give the maximum and minimum number of Sun-spot groups observed on any day for the months and years indicated:

MAXIMUM DAILY NUMBER OF SUN-SPOT GROUPS.

MONTHS.	1890.	1891.	1892.	1893.	1894.	1895.
January . .		4	11	11	10	7
February .		3	8	9	8	9
March . . .		2	6	10	8	8
April . . .		4	7	10	7	8
May		5	7	11	9	10
June		7	9	11	9	7
July		8	13	10	11	
August . .	2	5	10	14	8	
September.	2	8	9	9	9	
October . .	2	5	8	12	7	
November .	4	8	9	9	6	
December .	3	7	13	9		

MINIMUM DAILY NUMBER OF SUN-SPOT GROUPS.

MONTHS.	1890.	1891.	1892.	1893.	1894.	1895.
January . .		0	2	2	4	3
February . .		0	1	2	4	3
March . . .		0	1	3	3	4
April . . .		1	2	4	3	5
May		2	4	6	3	1
June		1	4	5	5	4
July		2	3	4	4	
August . .	0	0	4	6	2	
September .	0	1	3	4	2	
October . .	0	3	2	5	2	
November .	0	2	3	4	3	
December .	0	1	2	2		

ALTA, IOWA, October 9, 1895.

Latitude, $42^{\circ} 40' N.$ }
Longitude, 6h. 21m. W. }

DOUBLE-STAR MEASURES.

By R. G. AITKEN.

The following measures were made with the twelve-inch equatorial of this observatory. The position angle is usually the mean of four settings, and the distance that of three (occasionally four) double-distances. The position of the stars is given for 1880.0. The seeing is estimated by a scale on which 5 stands for the best conditions. The eye-piece used in most of the measures has a power of 545 diameters; but a few measures were made with lower powers.

Σ 13.

	R. A. $0^h 9^m 25^s$.	Decl. $+76^{\circ} 17'$.		
	θ_0	ρ_0	MAGNITUDE.	SEEING.
1895.664	$81^{\circ}.7$	$0''.73$	6.2 - - 6.2	4+
1895.681	84 .3	0 .81	6.2 - - 6.2	3+
1895.692	86 .4	0 .79	6.2 - - 6.3	3
1895.68	$84^{\circ}.1$	$0''.78$	6.2 - - 6.2	